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Fish silage and silage concentrates

Royal Seafood
Presentation by members of Royal Seafood Group

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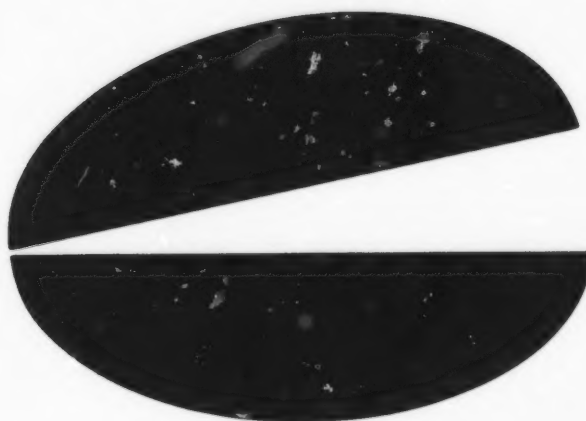
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RS - Feeds

RS-FÔR



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Bjugn Industrier A/S, 7160 Bjugn, tel: 076-28540 -

Mørefor A/S, 6560 Langøyeneset, Tel. 073-15413.

Member of Royal Seafood Group - Trondheim, Tel.: 07-51 52 11.

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The main goal for RS-Feeds suppliers is:

- To put feed users first.
- To supply nutrient-rich feed at competitive prices.
- To meet high sanitary requirements.
- To maximize the growth of farm-raised fish.
- To make fish farming even more profitable.
- On the whole, to supply feeds based on the needs of fish farmers.

This is achieved by:

- Reliable supply.
- Use of high-quality products.
- Choice of content of fat and protein (within certain limits).
- Simple product handling.
- Proper sanitary conditions during production, storage and transportation.
- Experience and knowledge.
- Good planning, efficiency and stable resources.

Bjugn Industrier A/S - Mørefor A/S

BJUGN INDUSTRIER A/S

Bjugn Industrier A/S was begun in 1983 in buildings belonging to Bjugn Fabrikker. In 1984 Bjugn Industrier A/S began construction of a feed kitchen for the supply of RS-pellets and RS-pasta, based on RS-silage as the basic raw material. The production of concentrated silage was brought up to full scale in 1985. This was accomplished through a long period of testing in a pilot plant

and experimentation. The products and the production technique have been under continuous improvement since the beginning, so that, today, products of especially high quality are supplied. In this process, the firm, together with the Institute of Nutrition, carried out the so-called "Bjugn experiment". The production process is heavily automated.

Mørefor A/S

Mørefor A/S began operation in 1985. The plant was built new from the ground up. At Mørefor, as well as at Bjugn Industrier A/S, production is based on supply of RS-wetfeed. Today, Mørefor A/S supplies all types of RS-wetfeeds and the other RS-products described.

Production/quality

RS-silage is made from fresh raw material; this is very important since the degree of freshness prior to the addition of acid/antioxidant is decisive to the quality.

RS-silage is pasteurized to arrest autolysis (decomposition of the fish) at the desired level.

The content of dry matter, protein and fat in RS-silage and RS-concentrate can be varied according to customer demands.

Silage is, in everyday language, an expression for feeds made by acid preservation. RS-products are made long-lasting with regard to microbial and enzyme activity, and may be kept in storage for a long period of time.

Ensilaging will only be carried out on products which are fresh. The raw material must be treated before fungi and bacteria occur in such amounts that the quality is reduced through, among other things, taste, smell, nutrient value and sanitary quality.

The limit for bacterial activity is set at pH 4.5 by the use of organic acids. The organic acids produce a better preservation effect at higher pH value than do inorganic acids.

Distribution

DISTRIBUTION OF FEED AND FEED RAW MATERIAL

Distribution for both Bjugn Industrier A/S and Mørefor A/S can be carried out either by boat or vehicle depending on what the receiver wishes or what is most practical. The firms have various means of transportation.

RS-concentrate, RS-pasta or RS-silage is shipped in tanks/bulk, while the other RS-products use vats/bags. As freight costs constitute a significant portion of the total cost, the firms are attempting to keep these costs as low as possible. Wherever practical and economically feasible, the firms attempt to carry return freight.

The firms recommend shipping 2-3 times a week for RS-pasta and RS-pellets. As RS-concentrate has a longer keeping quality, shipping can be done less frequently, depending on receiver capacity.

Products - Quality

Raw material : capelin, Norway pout
 herring, etc..
 offal

Acid
 Antioxidant

Raw silage**QUALITY CONTROL**

TVN volatile nitrogen pV rancidity
 pH degree of acidity (anisidine, peroxide)

Pasteurization

Separation Oil

Inspection

Storage tank RS-silage

Water
 (acid)

Evaporation**Monitoring**

RS-concentrate

RS-FEED RAW MATERIAL

**HOW RS-SILAGE AND THE STRUCTURE
AND COMPOSITION OF THE RS-CONCENTRATE
CAN BE VARIED.**

	Net weight kg/m ³	Dry matter %	Prot. %	Fat %
RS-silage	980	23	14	7
RS-concentrate	1150	50	34	10

RS-SILAGE
Dr.m. 20%
↓
RS-CONCENTRATE
Dr.m. 50%

2.5 kg

1.0 kg

**USE OF RS-SILAGE AND
RS-CONCENTRATE IN READY-
TO-USE PRODUCTS.**

50	50
RS-SILAGE	MEAL, ETC.

RS-PELLETS

60 40

RS-SILAGE	MEAL, ETC.
-----------	------------

RS-PASTA

65 35

RS-CONCENTRATE	MEAL, ETC.
----------------	------------

RS-PELLETS

75 25

RS-CONCENTRATE	MEAL, ETC.
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RS-PASTA

THE REQUIREMENTS OF FISH FOR FEED AND FEEDING

The feed is composed of dry matter and water.

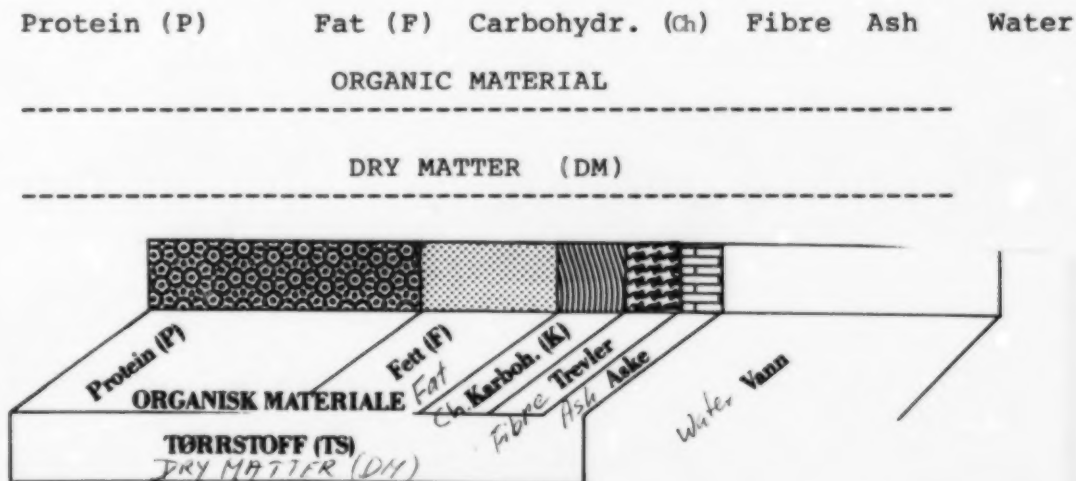
The dry matter portion consists of the three main nutrients (protein, fat and carbohydrates) in addition to some fibre (indigestible components) and "ash". The ash is that portion which remains if we do a complete combustion of the feed, and consists mainly of minerals from bones in the raw material. Protein, fat, carbohydrates and fibre constitute the organic portion of the feed, and it is from this that the fish draws energy for growth, maintenance, activity, combustion, etc.. The protein constitutes the greatest portion of the organic material,

and is the most important nutrient for the fish. This forms the foundation for protein conversion in the body and, hence, growth in muscle and other tissues.

Fish fat contains important components which fish need for tissue formation and for controlling the life processes. The main purpose of fat in the feed is to meet the need for combustion and formation of fat deposits.

In the wild, fish eat very little carbohydrates, and the carbohydrates are probably of little significance as substance. Ash contains minerals which the fish can utilize. Too high a content of ash might, however, retard the uptake of some of these minerals. Fibres are indigestible components of the organic material.

Schematic structure of a soft pellet is shown in the following:

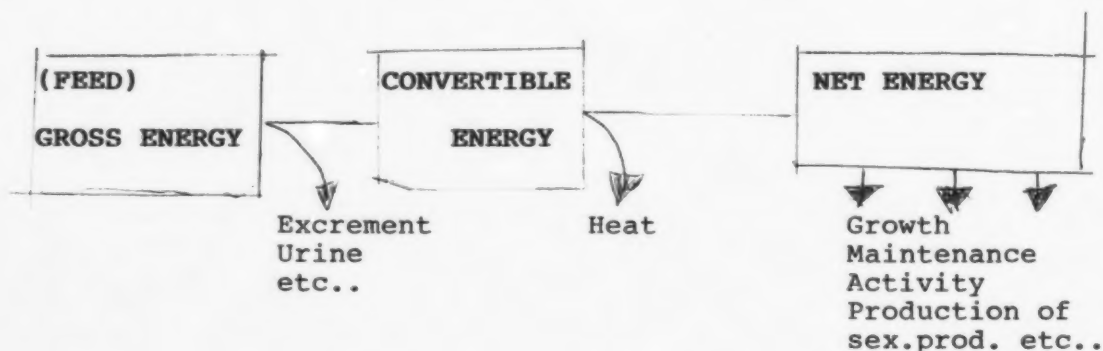


CONVERTIBLE ENERGY AND DISTRIBUTION OF NUTRIENTS

The energy content of the feed comes from the main nutrients, protein, fat and carbohydrates.

During combustion of one kilo of feed, a given amount of energy, which we express in calories (cal) or in Joule (J) is released. The fish cannot, however, utilize all this energy (gross energy).

It is normal to show this by a flow chart as shown below:



Gross energy is the energy the feed contains when the fish swallows it.

Convertible energy (CE) is the energy portion that remains when the losses through feces and urine/ammonia are subtracted from the gross energy. Convertible energy is now stated for all fish feed.

The feed eaten by the fish is always used to meet current needs. One thing that always must be remembered is that fish, as an animal, prioritizes growth the lowest. If the fish has high energy consumption, for instance, due to swimming activity,

this will result in increased combustion and consequently less growth. It is only the excess that is used for growth.

The figure above is purposely very much simplified. In reality, there are many factors which determine how much of the feed the fish can use for growth. Losses due to digestibility/availability of feed, poor protein quality, stress, poorly composed feed, and so on, are among the factors which, to a great extent, determine the utilization of the feed for growth.

If the fish can be kept free of disease, stress and possibly sexual maturity, it can utilize the feed to its maximum for growth. Up to about half of the protein which the fish ingests can then be broken down as protein energy.

To achieve this, a high sanitary and technical quality of the feed must be provided, at the same time as the main nutrients must be present in correct proportions.

ENERGY FROM PROTEIN

Experiments have shown that optimal utilization of the protein, as well as possibilities for maximum growth, are obtained if about 40 % of the total convertible energy in the feed comes from protein.

Farm-raised fish are often exposed to stress and disease. Under such conditions, the protein needs of the fish may be increased because it has a higher maintenance requirement.

As a feed supplier, we must consider this and we therefore feel that 40 - 50% of CE should come from protein. The proportions of fat and carbohydrates must be adjusted in relation to this. It is an obvious requirement that the protein itself must be of high quality and meet the fish's total requirements of amino acids. The amino acids are the "building blocks" which fish use to build their own body protein.

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RS-PROCESS A/S

HAS

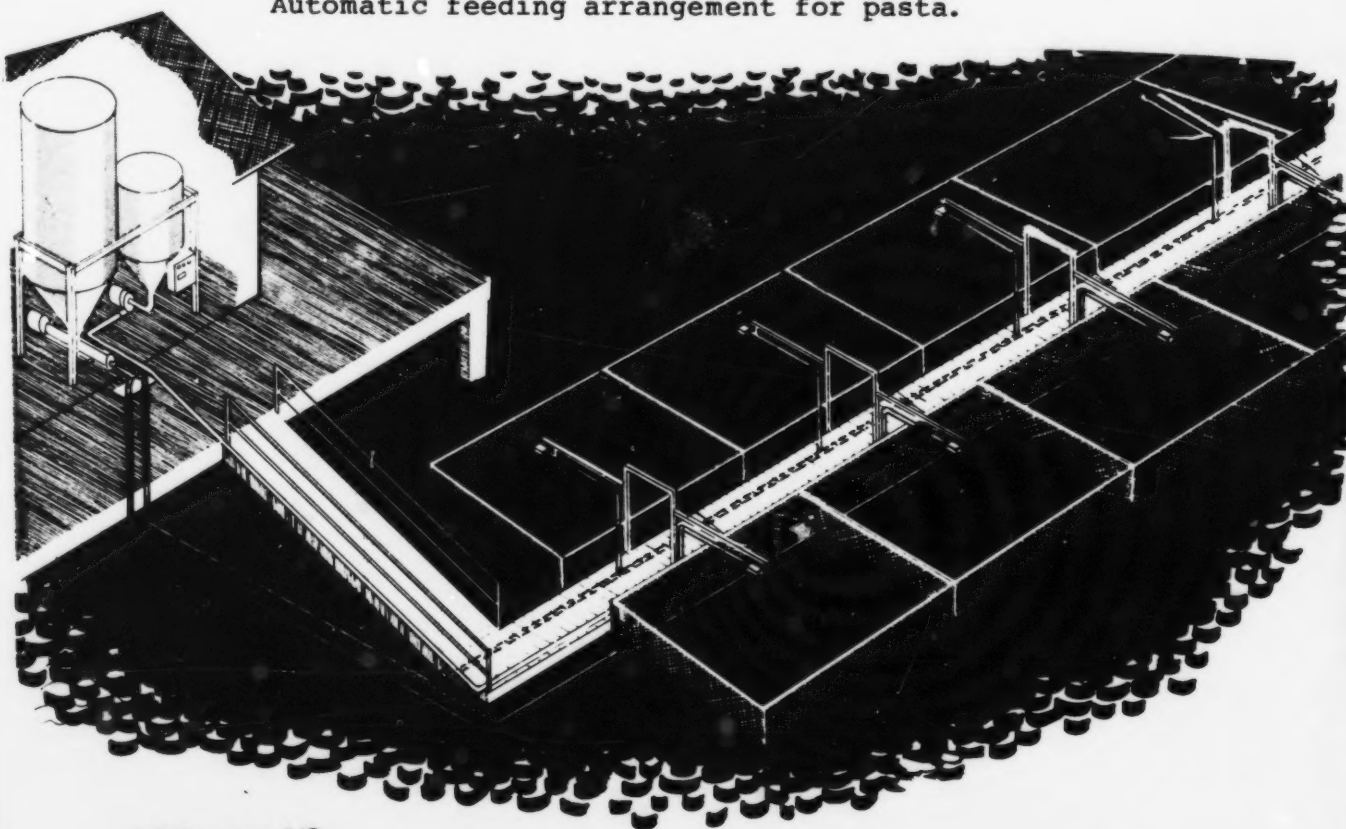
PROCESSING SOLUTIONS

Development and supply of

- * Equipment for energy retrieval.
- * Equipment for production of fish silage.
- * Pumps and valves.
- * Feed kitchen.

NEW !

Automatic feeding arrangement for pasta.



RS-Process A/S
i Royal Seafood-gruppen
Valentinlystsenteret 7000 Trondheim
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ENERGY FROM FAT

Fat is a much cheaper raw material than protein. Salmonid fish can effectively utilize fat in energy conversion and can also store much of it as body fat. Again, good quality fat is required. Experiments have shown that up to about half (50%) of the total convertible energy in the feed can be fat. The values ought to lie between 40 - 50%.

The fat is composed of fatty acids. Some of the fatty acids are mentioned as essential. These the fish cannot produce itself, and must therefore have them supplied through the feed. Cold water fish require a specific content of polyunsaturated fatty acids in the feed, much of which can be found in cod-liver and capelin oil. Typical signs of unsaturated fatty acids are that they remain liquid at lower temperatures than saturated ones (e.g. fat from mammals).

ENERGY FROM CARBOHYDRATES

Salmonid fish can utilize carbohydrates in feed to only a limited extent. This is because the fish does not produce sufficient amounts of enzymes to break down large amounts of starch.

Up to 12% of the convertible energy is assumed to originate from carbohydrates. The carbohydrate raw products are cooked or extruded.

The indigestible portions function as filler substances in the feed. A too high mixture of poorly digestible carbohydrates may

have a negative effect on the digestion of protein in the feed. Since there has been a great deal of discussion as to whether any harmful long-term effects may occur from too much carbohydrate, we have made it our aim to reduce the carbohydrate portion as much as possible in ready-to-use soft feed or pasta.

The amount of convertible energy in protein, fat and carbohydrates is:

	MJ CE per kg
Protein	16.36
Fat	33.47
Carbohydrates, uncooked	6.70
Carbohydrates, cooked (gelatinized)	9.62
Carbohydrates, pressed	13.40

Earlier, we preferred to use calories (cal) as a measure of energy. Scientists all over the world are now in agreement that Joule is a more precise measure. The difference in numerical magnitude of calories and Joule is:

$$1 \text{ cal} = 4.184 \text{ Joule}$$

VITAMINS AND MINERALS

Fish need vitamins for normal growth and good health, to develop sexually and to maintain normal metabolism. Some vitamins are usually found in ample amounts in the fish feed, while others may be lacking.

Some important vitamins which may be lacking are:

Vitamin E (alpha-tocopherol):

Together with antioxidant used during preservation of RS-silage, Vitamin E will protect the fish's own fat. The cell walls, in particular, are exposed to degradation during vitamin E deficiency. The degradation is an oxidation, and vitamin E functions as an antioxidant. The mineral selenium, together with vitamin E, will enhance this effect.

Thiamine (vitamin B1):

Participates in carbohydrate and energy metabolism. Many feed fish contain an enzyme which breaks down thiamine; so-called thiaminase. Thiaminase starts acting as soon as the fish is dead, and it is stopped by pasteurization in RS-feeds.

Vitamin C (ascorbic acid):

Just like vitamin E and the mineral selenium, vitamin C prevents oxidation (rancidification) of body tissue. The most important task for vitamin C is, however, to contribute to the building of the skin and spine. Healing of wounds is quicker with sufficient amounts of this vitamin. Vitamin C is not very stable and is easily lost through poor treatment of the feed.

SIGNS OF VITAMIN DEFICIENCY by researcher Finn Utne,
Ernæringsintituttet (Institute of Nutrition).

Vitamin	Requirement mg/kg dry matter	Symptoms
Vitamin A	2000-2500 IU	Accumulation of liquid in the peritoneum , umbilical hernia, bleeding of the kidneys.
Vitamin E (a-tocopherol)	60	Fragility of red blood cells with subsequent anemia, edema, accumulation of fat in the liver and spleen, protruding eyes, retention of liquid in the pericardium.
Vitamin K (menadione K ₃)	5	Anemia, bloody areas on the gills, eyes and vein tissue, elongated blood coagulation time.
Thiamine (B ₁)	10	Reduced appetite, muscle atrophy, cramps, instability and loss of balance.
Riboflavin (B ₂)	20	Dull eye lenses, bloody eyes, photophobia , decreased vision, dark skin, abnormal pigmentation of the iris, wrinkly constriction of the stomach wall, anemia.
Pantothenic acid	40	Club-shaped gills, weakness, local necrosis of tissue cells, inflammatory secretion in the gills, decreased activity (resting position on the bottom).
Pyridoxine (B ₆)	10	Nervous disturbances, epileptic seizures, disturbance of muscular coordination, anemia, rapid gill-cover movements and gulping of air, rapid rigor mortis.
Niacin	150	Colon damage, jerky movements, lassitude, muscle cramps when resting, swelling of stomach and colon.
Folic acid	5	Apathy, tail fin easily damaged, anemia, dark colour.

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Vitamin B ₁₂	0.02	Irregular amounts of red blood cells, fish dark-coloured, anemia.
Biotin	1.5	Lack of appetite and apathy before deficiency shows up, damage to colon, muscle loss, severe convulsions, fragmented pieces of red blood corpuscles, skin damage.
Inosit _{ol}	300	Bloated stomach, extended voiding time for stomach, skin damage.
l-ascorbic acid	400	Scoliosis or lordosis of spine, impaired collagen formation (poor healing of skin), increased growth of jaw and snout, changes in use of gills, bleedings in skin, liver, kidneys, intestines and muscles.
Choline	600	Bleeding of kidneys and intestines.

MINERALS

Minerals are needed for body building and for normal bodily functions. Fish absorb some minerals, partly through uptake directly from the water. The remainder is obtained through the feed. Salt water contains more minerals than fresh water.

Deficiency of phosphorus or magnesium may result in reduced growth, high feed consumption and poor bone formation. Magnesium deficiency also shows up as increased excretion , curvature of the spine and changes in musculature and gills. In extreme cases, zinc deficiency results in abundant excretion , worn fins, loose scales and cataracts, that is, blackening of the eyes. Symptoms of selenium deficiency often occur in conjunction with symptoms of vitamin E deficiency.

TASTE AND COLOUR

In the wild, fish naturally seek the nutrients which taste best. The raw products that are used for fish feed do not all taste equally good. In general, this applies to all types of feed raw material. Much also depends on how the raw material is treated.

In RS-feed we try to arrive at compositions which increase the tastiness and, hence, the uptake of nutrients.

In combinations with the colourants which might exist in the binding agent, RS-shrimp meal is added to the RS-feed. RS-shrimp meal contains astaxanthin, a pigment natural for fish.

CORRECT FEED COMPOSITION

Feed composition has been the topic of discussion, and it is a subject still being developed.

It appears that we now know the relationship between the main nutrients and how they should be balanced in a feed mix.

It is normal to calculate the nutrients as convertible energy (CE). The factors used for this are the following:

CE from protein = 3.9 kcal/g = 16.36 kJ/g

CE from fat = 8.0 kcal/g = 33.47 kJ/g

CE from Ch* = 2.3 Kcal/g = 9.62 kJ/g

* = Presumes gelat. carbohydrates with digestibility of approx. 55%.

The energy values indicate that fat is the most energy-rich, while protein and carbohydrates produce considerably lower values. At the same time, fat is much cheaper than protein. This leads us to strive for an ideal situation where most of the fat is used for nutrient conversion and the greatest possible portion of the protein is used for muscle growth. This is possible to achieve with a balanced feed, and the result is then that the fat saves on protein.

This is so important that it is worth repeating: The protein is used for muscle growth and to replace losses through protein conversion (maintenance). The fat is used for energy conversion and to form the basis for fatty deposits in the body of the fish. The carbohydrates can, to some degree, be used as energy.

Two extreme examples are given below to clarify this situation. As one alternative, feed can be made from pure protein. The fish will then have its requirements for maintenance of the body proteins met. At the same time, it will be possible for the fish to form muscle proteins. In addition, the protein in the feed must be sufficient to offset all energy conversion. Any excess will be converted to fat. It is easy to understand that this is a very expensive way of using protein.

The other alternative is feed composed of fat only. The fish will then have its requirements for energy conversion met as well as

the other requirement which the fat must meet. But the fish cannot form muscle protein because the fat cannot be converted to protein and it therefore cannot grow at all.

The third alternative, and which provides correct feed, is to ensure that the content of protein and fat is balanced. If the amount of energy from protein meets the requirements for maintenance of body proteins, as well as meeting the requirements for maximal muscle growth (protein growth), the fat can look after the rest by meeting the requirements for energy conversion and form the basis for fat deposits. We have then achieved what we wanted, namely, that we do not use more expensive protein than necessary.

The main role of carbohydrates is to function as a filler in the feed, while some can be used for energy conversion.

CORRECT FEEDING

Even if the feed has the right composition, it does not necessarily mean that we achieve full utilization of the feed. It is therefore very important that it be fed properly and in correct amounts. The amount of feed needed to produce 1 kg salmon is called the feed factor. It has been found that with a well-balanced feed, according to the criteria previously discussed, about 0.9-1 kg dry matter is needed to produce 1 kg fish (round weight). If the feed contains 70% dry matter, the feed factor will be $0.9:0.7 = 1.3$.

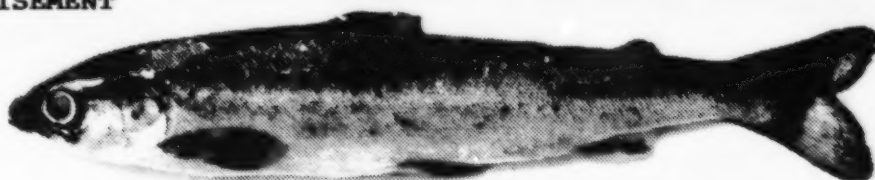
A better way of calculating this is to give the amount of energy needed to produce 1 kg fish. The assumption is still a correctly composed feed. In our calculations we assume that fish from 0.5 - 5kg which grow in salt water, require about 18 MJ (= 4.3 Mcal) CE to grow one kilogramme.

If, for instance, the feed contains 12.5 MJ CE/kg, this would mean a theoretical feed factor of $18:12.5 = 1.44$.

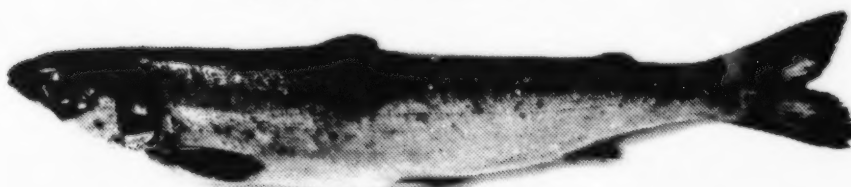
If overfeeding takes place, excess feed will be wasted and will result in pollution. This results in a higher feed factor. If, on the other hand, underfeeding is done, then the fish will use the greater portion of the food for maintenance and energy conversion in the body. This will result in a smaller portion being used for growth. Remember, growth has the lowest priority.

Conclusion:

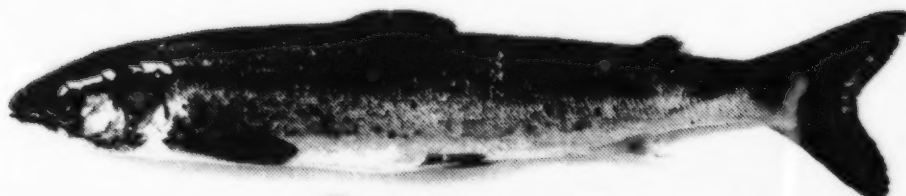
Correct feeding is just as important as correct feed composition.

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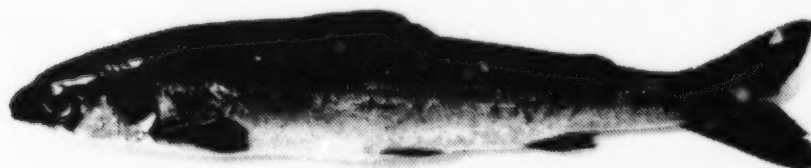
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WE HAVE MADE THEM ALL HAPPY (SALMON)*

Fish farming is in the process of outgrowing common beginner problems. Sea farming is no longer just a lottery; experience

*Play on words: Laks (=salmon): Old Norse:lax = a person free from care. English equiv.: "Happy as a lark".TR.

and knowledge are brought into the system, among other things through the aid of computer technology. EDP systems are necessary aids to achieving effective processing of orders, storage control and shipping of quality products to demanding buyers at home and abroad. As well, our operational systems for hatcheries using feed planning and financial control are important aids for those who want to operate profitably in sea farming.

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Scanvest Ring Data and Maritech are suppliers of well-tested **administrative** control systems based on Scanvest PC and Corvus and Novell network for fishing and sea farming industries. Briefly: **We supply everything for fishing and sea farming industries.** Our solutions on micro-computer include: Operational systems for fish farms, feed planning, financial control, calculation of shares, raw fish calculations, accounting systems, payroll systems, ordering, storage and invoice systems, word processing. Scanvest Ring Data developed, based on Datapoint mini- and super mini-computers, special systems for sale of fish

at home and abroad. Handling of orders domestic/export, storage at the pallet/crate stage, communications with producers/fish farmers for reporting of production, invoicing with producers/sales associations, invoicing inland - export, export declarations with licence applications, customs declarations. CMR-freight bills and word processing with TELETEx/Telex. We have, of course, full integration with our accounting and financial control systems. We also have integration programs between micro-computers (PC) and mini-computers (Datapoint).

HOW TO USE THE FEED.

PLANNING

It is important to plan the purchase of feed properly.

Unnecessarily long storage of feed results in reduced feed quality in addition to tying up capital, in other words, poor financial management. Purchase of large amounts of feed due to anticipated price increases, reasonable freight and so on may be poor feed economy, since it usually results in longer storage periods than normally necessary.

STORAGE

RS-concentrate and RS-silage can, under normal conditions, be stored in closed tanks having adequate circulation. RS-pasta and RS-pellets should be stored dry, dark and cool.

Some of the vitamins are lost during storage and, under unfavourable storage conditions, this break-down can take place quickly.

STORAGE OF FEED IN SILO

Storage of fish feed in silos is a practical and economically favourable storage method and results in more rational handling of the feed. Nevertheless, there are certain factors to be aware of in this connection:

- a) Be particular with outside maintenance and regular cleaning. Watch particularly feed entry and exit areas, as well as inspection hatches.

- b) The feed silo must be completely emptied regularly. If necessary, it should also be washed and disinfected. All feed remnants must be removed prior to washing and disinfection.

If you have any questions regarding disinfection and chemical cleansing, contact us.

FOOD-FISH OPERATIONS

Handfeeding or handfeeding in combination with automated feeding is most common in food-fish operations. There are automatic feeders for both dry pellets and soft feed/wet feed. Some automatic feeders distribute (spread) the feed in the enclosure, while others drop the feed straight down. Automatic feeders are available in various sizes and types of material.

FEEDING AT LOW TEMPERATURE

Feed uptake diminishes when the temperature drops. When a rapid drop in temperature is expected, feeding should be reduced ahead of time; fish having too much feed in the stomach have a poor capacity to adapt to the rapid drop in temperature. At a temperature near 1 - 2°C the feed uptake is very little. Nevertheless, we suggest feeding even then, because a complete halt in feeding appears to stress the fish. Avoid the use of heavily cooled or frozen feeds.

FEEDING AT HIGH TEMPERATURE

Salmonid fish require water rich in oxygen. The content of oxygen decreases when the temperature rises, at the same time as the fish's requirement for oxygen increases. At high temperatures (above 16°C), heavy feeding may lead to oxygen deficiency. This shows up in reduced weight, poor well-being and risk of disease.

FEEDING WHEN THE FISH SHOW SIGNS OF DISEASE

Reduce or stop all feeding and contact a veterinarian immediately. The veterinarian will then prescribe the right treatment and possibly recommend use of special feed or medical treatment. RS-Feed can be produced in accordance with veterinary prescriptions.

FEEDING BEFORE SLAUGHTERING

To obtain good slaughter quality, it is important to use correct RS-Feed where emphasis is placed on arriving at a correct ratio between nutrients in addition to selecting top quality raw products. The slaughter quality then has the best opportunity of becoming good.

With regard to feeding and starvation periods before slaughtering, we recommend that directives from the Fish Farmers Sales Association be followed.

FEEDING OF FISH WHICH HAVE BECOME SEXUALLY MATURE.

Feed uptake among mature fish is usually reduced compared with immature fish. As long as the temperature is high, the fish will ingest some feed, but at falling temperatures during the winter, the feed uptake is reduced to a minimum.

It is important to maintain feeding throughout the winter. RS-Feed used should have a high vitamin and protein content. Fish becoming sexually mature will show signs of the maturity (discolouration) already in July/August the following year and should therefore be slaughtered as soon as they obtain satisfactory condition and quality.

FEEDING OF BROOD STOCK

When the fish reproduces, it will place greater demands on the feed: high protein quality, balanced energy content, vitamins and minerals.

In the last months before stripping, the feeding must be heavily reduced and then completely stopped. This produces the best roe quality and we avoid pollution from excrement during the stripping process.

TECHNICAL QUALITY

The goal is that as much of the RS-Feed as possible should produce the greatest possible financial return. The RS-pellets

must be firm enough to withstand transportation shock without breaking. RS-pasta must be of a technical quality suitable for automatic feeding.

Feed uptake will depend on good taste and normal sinking rate. The size of the particles must suit the size of the fish. A cross-section which corresponds to between 2.2 and 2.6% of the length of the fish is recommended. The length of the pellet should be 1.5 - 2.5 times its cross-section.

TABLES:

RS-FEED

FEED MIXTURE

RS-Pasta I

Feed mixture

Feed raw material	Amount feed raw material %	Dry M. %	Content of nutrients			Price per kg feed raw material	Cost per feed raw material
			P %	F %	C %		
RS-concentrate	34.25	17.1	11.7	3.4	-		
RS-silage	34.25	7.9	4.8	2.4	-		
RS-oil	6.0	6.0	-	6.0	-		
Pellet mix	20.0	18.0	8.4	1.4	6.4		
RS-shrimp meal	4.0	3.6	1.6	0.1	-		
Blood meal	1.0	0.9	0.9	-	-		
Vitamin conc.	0.5	0.5	-	-	-		
Total	100	54.0	27.4	13.3	6.4	Total FC I	
Ratio between nutrients in DM		100	50.7	24.6	11.8		
CE (convertible energy) from nutrients in the mix in MJoule		9.54	4.47	4.45	0.62		
CE percentage distribution		100	46.9	46.6	6.5		

Amount feed mixture
for 1 kg DM: 1.85

Preparation Cost

Feed price per MJoule CE ($\frac{FC}{CE}$):

Total FC II

Feed price per kg DM ($\frac{FC}{DM}$):

RS-Pasta II

Feed Mixture

Feed raw material	Amount feed raw material %	Dry M. %	Content of nutrients			Price per kg feed raw material	Cost per feed raw material
			P %	F %	C %		
RS-concentrate	66.5	33.3	22.6	6.7	-		
RS-silage	-	-	-	-	-		
RS-oil	8.0	8.0	-	8.0	-		
Pellet mix	20.0	18.0	8.4	1.4	6.4		
RS-shrimp meal	4.0	3.6	1.6	0.1	-		
Blood meal	1.0	0.9	0.9	-	-		
Vitamin Conc.	0.5	0.5	-	-	-		
Total	100	64.0	33.5	16.2	6.4	Total FC I	
Ratio between nutrients in DM		100	52.3	25.3	10.0		
CE (convertible energy) from nutrients in the mix in MJoule		11.51	5.47	5.42	0.62		
CE percentage distribution		100	47.5	47.1	5.4		

Amount feed mixture
for 1 kg DM : 1.56

Preparation Cost

Feed price per MJoule CE ($\frac{FC}{CE}$):

Total FC II

Feed price per kg DM ($\frac{FC}{DM}$):

RS-Pasta III

Feed Mixture

Feed raw material	Amount feed raw material %	DM %	Content of nutrients			Price per kg feed raw material	Cost per feed raw material
			P %	F %	C %		
RS-concentrate	-	-	-	-	-		
RS-silage	60	13.8	8.4	4.2	-		
RS-oil	5	5	-	5			
Pellet mix	30	23.4	10.9	1.8	9.6		
RS-shrimp meal	3.5	3.2	1.4	0.1	-		
Blood meal	1	0.9	0.8	-	-		
Vitamin Conc.	0.5	0.5	-	-	-		
Total	100	46.3	21.5	11.1	9.6	Total FC I	
Ratio between nutrients in DM		100	46.4	24.0	20.7		
CE (convertible energy) from nutrients in the mix in MJoule		8.16	3.52	3.72	0.92		
CE percentage distribution		100	43.1	45.6	11.3		

Amount feed mixture
for 1 kg DM : 2.16

Preparation Cost

Total FC II

Feed price per MJoule CE ($\frac{FC}{CE}$):

Feed price per kg DM ($\frac{FC}{DM}$):

RS-Pellet I

Feed Mixture

Feed raw material	Amount feed raw material %	DM %	Content of nutrients			Price per kg feed raw material	Cost per feed raw material
			P %	F %	C %		
RS-concentrate	52.0	26.0	17.7	5.2	-		
RS-silage	-	-	-	-	-		
RS-oil	9.0	9.0	-	9.0	-		
Pellet mix	33.5	30.2	14.1	2.3	10.7		
RS-shrimp meal	4.0	3.6	1.6	0.1	-		
Blood meal	1.0	0.9	0.9	-	-		
Vitamin Conc.	0.5	0.5	-	-	-		
Total	100.0	70.2	34.3	16.6	10.7	Total FC I	.
Ratio between nutrients in DM		100	48.8	23.6	15.2		
CE (convertible energy) from nutrients in the mix in Mjoule		12.18	5.59	5.56	1.03		
CE percentage distribution		100	45.9	45.6	8.5		

Amount feed mixture
for 1 kg DM: 1.42

Preparation Cost

Total FC II

Feed price per MJoule CE ($\frac{FC}{CE}$):

Feed price per kg DM ($\frac{FC}{DM}$):

RS-Pellet II

Feed Mixture

Feed raw material	Amount feed raw material %	DM %	Content of nutrients			Price per kg feed raw material	Cost per feed raw material
			P %	F %	C %		
RS-concentrate	26.0	13.0	8.8	2.6	-		
RS-silage	26.0	6.0	3.6	1.8	-		
RS-oil	7.0	7.0	-	7.0	-		
Pellet mix	37.5	33.7	15.7	2.6	12.0		
RS-shrimp meal	2.0	1.8	0.8	-	-		
Blood meal	1.0	0.9	0.9	-	-		
Vitamin Conc.	0.5	0.5	-	-	-		
Total	100.0	62.9	29.8	14.0	12.0	Total FC I	
Ratio between nutrients in DM		100	47.4	22.3	19.0		
CE (convertible energy) from nutrients in the mix in Mjoule		10.71	4.87	4.69	1.15		
CE percentage distribution		100	45.5	43.8	10.7		

Amount feed mixture
for 1 kg DM : 1.59

Preparation Cost

Total FC II

Feed price per MJoule CE ($\frac{FC}{CE}$):

Feed price per kg DM ($\frac{FC}{DM}$):

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RS-Pellet III

Feed Mixture

Feed raw material	Amount feed raw material %	DM %	Content of nutrients			Price per kg feed raw material	Cost per feed raw material
			P %	F %	C %		
RS-concentrate	-	-	-	-	-		
RS-silage	45	10.4	6.3	3.2	-		
RS-oil	7.0	7.0	-	7.0	-		
Pellet mix	44.5	40.0	18.7	3.1	14.2		
RS-shrimp meal	2.0	1.8	0.8	-	-		
Blood meal	1.0	0.9	0.9	-	-		
Vitamin Conc.	0.5	5	-	-	-		
Total	100	60.6	26.7	13.3	14.2	Total FC I	
Ratio between nutrients in DM		100	44.1	21.9	23.4		
CE (convertible energy) from nutrients in the mix in Mjoule		10.19	4.37	4.45	1.37		
CE percentage distribution		100	42.9	43.7	13.4		

Amount feed mixture
for 1 kg DM : 1.65

Preparation Cost

Total FC II

Feed price per MJoule CE ($\frac{FC}{CE}$):

Feed price per kg DM ($\frac{FC}{DM}$):

RS-Pellet IV

Feed Mixture

Feed raw material	Amount feed raw material %	Content of nutrients				Price per kg feed raw material	Cost per feed raw material
		DM %	P %	F %	C %		
RS-concentrate	69.5	41.7	22.2	13.9	-		
RS-silage	-	-	-	-	-		
RS-oil	-	-		-	-		
Pellet mix	26.0	23.4	10.9	1.8	8.3		
RS-shrimp meal	3.0	2.7	1.2	0.2			
Blood meal	1.0	0.9	0.7				
Vitamin Conc.	0.5	0.5					
Total	100	69.2	35.0	15.9	8.3	Total FC I	
Ratio between nutrients in DM		100	50.6	23.0	12.0		
CE (convertible energy) from nutrients in the mix in Mjoule		11.85	5.73	5.32	0.80		
CE percentage distribution		100	48.4	44.9	6.7		

Amount feed mixture
for 1 kg DM : 1.45

Preparation Cost

Total FC II

Feed price per MJoule CE ($\frac{FC}{CE}$):

Feed price per kg DM ($\frac{FC}{DM}$):

Feed Mixture

Feed raw material	Amount feed raw material %	DM %	Content of nutrients			Price per kg feed raw material	Cost per feed raw material
			P %	F %	C %		
RS-concentrate							
RS-silage							
RS-oil							
Pellet mix							
RS-shrimp meal							
Blood meal							
Vitamin Conc.							
Total							Total FC I
Ratio between nutrients in DM							
CE (convertible energy) from nutrients in the mix in <u>Mjoule</u>							
CE percentage distribution							

Amount feed mixture for 1 kg DM:

Preparation cost

Feed price per MJoule CE ($\frac{FC}{CE}$):

Total FC II

Feed price per kg DM ($\frac{FC}{DM}$):

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